of laser operation. This theory treats the electromagnetic field in its classical (Maxwell) formalism; the gas is treated in its quantum-mechanical (Dirac) formalism. Using the rate-equation approximation, the discussion centers on the properties of the gain coefficient. An excellent discussion of plasma dispersion and line broadening completes this chapter.

The third chapter presents W. E. Lamb's theory of operation of a gas laser. Unfortunately, by changing notation, and inserting some (interesting) implications, the authors have not appreciably clarified this classic theory. For all its errors, the chapter in the *Quantum Electronics Proceedings* is still to be preferred from a pedagogical standpoint.

The discussion of mode structure reviews the basic physics of electromagnetic radiation confined in a cavity with losses present. This is perhaps the best section, as theory and diagrams work together to present a very clear understanding of a very complex subject. The discussion of longitudinal modes is not as detailed as that on transverse modes. Of particular interest is the section on general curved-mirror cavities.

The book concludes the theory, with a very limited discussion of the factors governing output power. Difficulties in obtaining good theoretical predictions are lightly glossed over. Not until the final chapter are the authors concerned with the technical details involved in actually constructing a gas laser. The summary of symbols at the beginning of this book and the appendixes at the end are useful for the reader.

The authors, presently employed by Spectra-Physics, Inc, have presented their material in a clear, concise manner. The graduate student who has completed quantum mechanics should have little difficulty with this book.

MARY E. COX
*Flint College*
*University of Michigan*

## Einstein Spaces

**By A. Z. Petrov**
411 pp. Pergamon, New York, 1969. $18.00

For years this book had to be consulted by researchers either in the original Russian or in a later German version. Now at last it has become available in English. It is a mine of unique information: A. Z. Petrov deliberately tried to limit himself to questions not treated elsewhere. For this and other reasons his book is not intended for one's first acquaintance with general relativity. Nor should the reader expect enlightenment on the more physical aspects of the theory. It is a book written by an excellent mathematician whose interest lies mainly in the formal mathematical structure of space-times. Certain aspects of this structure are here treated with encyclopedic thoroughness.

In a sense, all space-times of Minkowskian signature $(+ - - -)$ can be regarded as gravitational fields, generated, however, by energy and momentum distributions (obtainable directly from the metric by Einstein's field equations) that will be generally not very interesting and often downright unphysical (for example, with negative energy density). The special class of space-times corresponding to a vacuum have more chance of being physically significant. Here the sources must be sought in the mathematical singularities, if any. Gravitational waves are studied in such spaces. They are called "Einstein spaces" and are characterized by the constant proportionality of the metric with the Ricci tensor.

Petrov's title suggests that his book is concerned exclusively with such spaces. To this extent it is misleading: The title is evidently meant to encompass all space-times arising in relativity, and some of their generalizations. A more fitting title would be "New Methods in the General Theory of Relativity" —as this book was actually called in its later (1966) Russian edition. (Though purportedly a revised translation of the first Russian edition of 1961, the present version appears more akin to the 1966 Russian and 1964 German editions, neither of which, however, it fully coincides with.)

Petrov is probably best known for his 1954 work on the local algebraic classification of space-times by their Weyl tensor. Naturally, this famous "Petrov classification" is in the present book. After Felix Pirani introduced it to the Western world in 1956, it became an important item in the armory of modern researchers. Though Pirani's first attempt to correlate "Petrov degeneracy" directly with gravitational radiation turned out to be too optimistic, most subsequent work on gravity waves (and also on exact solutions of Einstein's field equations) at some stage made contact with Petrov's classification, especially through the powerful Goldberg-Sachs theorem, which geometrically characterizes Petrov degeneracy in the large.

But Petrov's book also contains another, and possibly even more important, classification of space-times, namely by the continuous groups of motions that they admit. The author proceeds along the lines that Bianchi introduced many years ago for the classification of positive-definite three-spaces using Lie-group theory. It is probably in this

part of the book that anyone in search of examples or counterexamples will be rewarded. It can also be recommended to professors in search of dissertation problems, for the physical significance of much of this work remains yet to be tapped. In fairness, it should be pointed out that the original edition contained calculational errors, but I hope these have now been eliminated.

Other topics discussed are conformal, geodesic and projective mappings of Riemannian spaces, the Cauchy problem for the Einstein field equations and special types of gravitational fields. In addition, there is an interesting bibliography of over 500 items. It may safely be predicted that this book will be an indispensable part of any relativity library for many years to come.

WOLFGANG RINDLER
*University of Texas, Dallas*

## Magnetodynamique Des Fluides

**By Henri Cabannes**
(2nd edition) 289 pp. Centre de Documentation Universitaire, Paris, 1969.
[Translated as *Theoretical Magnetofluiddynamics* by M. Holt. Academic, New York, 1970. $12.50]

In 1832 shortly after his epoch-making discovery of electromagnetic induction, Michael Faraday conceived the idea that an electrically conducting fluid flowing across the lines of force of the earth's magnetic field should have an electric current induced in it. He tried out his idea in the River Thames at London, though without success. Nevertheless, this was the origin of the subject now known as "fluid magnetodynamics" or more familiarly, in the case of flowing liquids, as "magnetohydrodynamics." This discipline has recently achieved much attention both from the standpoint of its engineering possibilities as well as its basic interest for astrophysics and for the flow of highly ionized fluids through magnetic fields.

In the volume under review the well known professor in the Faculty of Sciences in Paris (Sorbonne) has provided a thorough introduction to the theoretical basis of fluid magnetodynamics. He develops the general equations for a conducting fluid moving through a magnetic field and discusses the conditions under which they are exactly soluble. The author considers not only the case of the propagation of small disturbances through such a fluid but also shock waves. Diffraction around obstacles and propagation through tubes are also considered.

The treatment is theoretical throughout, and there is no discussion of experimental results. The presentation is clear, and the book should be useful to all who are interested in the basic principles of fluid magnetodynamics and have the appropriate mathematical competence in dealing with the partial differential equations of fluid dynamics and electromagnetism.

R. BRUCE LINDSAY
*Hazard Professor of Physics*
*Brown University*

## Electrons de Conduction et Surface de Fermi des Métaux

**By Cl. Boulestiex, M. Bruneaux**
124 pp. Dunod, Paris, 1969. 24 F

The purpose of this book is to introduce the reader to the Fermi surface, the experimental methods for determining it and its relation to magnetic properties of solids.

The first part is a review of the electron theory of solids. It is extremely compressed and, in particular, the description of the Fermi surface is so brief that it leaves one with many names and little understanding.

The second part discusses transport problems and the Fermi surface, but again the presentation is far too condensed.

The last and longest part is concerned with the relation of the Fermi surface to magnetic properties. There are very brief descriptions of cyclotron resonance, galvanomagnetic effects, deHaas–Van Alphen effect, deHaas–Shubnikov effect and others. Again I found many of these described much too briefly.

I feel that the monograph would have been much more effective if it had assumed previous reading of one of the standard texts and had devoted its limited space to the discussion of magnetic effects, which are the center of interest at the present time.

MORTON HAMERMESH
*University of Minnesota*

## Ultrasonic Methods in Solid State Physics

**By Rohn Truell, Charles Elbaum, Bruce B. Chick**
463 pp. Academic, New York, 1969. $19.75

This book will be of great value to experimentalists beginning research work in this field. It starts off with a rather elementary classical treatment of wave propagation in solids and then presents an excellent description of the experimental methods and techniques involved in pulse-echo measurements in the megahertz range. The experi-